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THERMAL WATERS
OF
WESTERN CANADA

Being a Paper read before the
"Scientific Club" at Manitoba
University during the 1907 Season

BY

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THERMAL WATERS OF WESTERN CANADA

This promiscuous synopsis of an unfinished study of the hot springs of Western Canada would never have been presented, had I not repressed all consciousness of the enormous work spent by patient labourers in every field of research. The limited time which a technologist crowded with the application of scientific discoveries (generally of others) to the commercial problems of a railroad company, is able to give to such a subject, ought to be sufficient apology for its imperfections, which I hope will afford the more scope for an interesting discussion by those whose knowledge may be more highly specialised.

GEOGRAPHICAL DISTRIBUTION

Any attempt on my part to describe the scenic setting of these springs, especially to those who may easily have seen more of the country in the vicinity of the Rocky Mountains than has been my privilege, will be quite unprofitable, so I shall merely confine myself to stating where the various better known springs are to be found, with brief description of those most accessible in this section.

Banff—Supposing we are travelling westward, the first thermal springs we find are at Banff, almost on the western borders of Alberta, just as we encounter that line of least resistance or of greatest interference of stratified rocks, that great chain of Rocky Mountains. The Alpinic town of Banff is 4,521 above the sea level and the springs, several in number, issue from about 500 feet higher up the side of what is called "Sulphur Mountain." In every instance there is an enormous deposit of tufa around the points of issue, which gives the impression that both the quantity and pressure of discharge were in the nature of Geysers, the ancient falling fountains both denuding and petrefying the formations upon which they fell. Evidences of the water having been ejected to great height are furnished by the tufa formation far above the present issue of the water. Above all this, Sulphur Mountain towers 8,030 feet, there being a small meteorological station on the summit.

There is nothing very striking about the immediate spot from which the water issues, this having been rudely excluded from view by masonry, but a view of the uprising water may be obtained by removing a manhole when a "welling-up" motion from under a limestone rock is defined by particles of sulphur suspended in the water.

The temperature of the water varies according to the season of the year, it was recorded by me in September, 1905, at 116°F., Mr. McGill, the Dominion Government Analyst at Ottowa, having previously recorded it at 115.5°F.

The other important springs issue from a point further to the north side of the same mountain, from a cave, the roof of which bears a crystalline deposit, apparently formed from the vapours, and secreted beneath the crystals Sulphurous Anhydride is detectable.

There are various other streams and so-called springs having various names, such as "Kidney" and "Liver," but, after laboriously tracing two on my hands and knees through rocks and ferns, I proved that they were merely deltas or reappearances of these two main springs, and concluded that several of the others have a common source.

There is a strong odour of Sulphuretted Hydrogen at the main springs, and their courses provide beds for luxuriant growth of some warm water Algae of citron colour, upon which sulphur deposits in whitish yellow powder as the water oxidises in its fall down the mountain slopes.

The Sulphuretted Hydrogen was estimated by decinormal standard Iodine solution and starch at the springs, and was found to be from about 1 to 2 c.c. per litre according to location.

I also discovered that bright silver coins were not discoloured by immersion in the water, except just where it first issues from the rocks, demonstrating in a rough manner that the water changes immediately on exposure to the atmosphere, and, in fact, Professor Parker was unable to discover any Sulphuretted Hydrogen in a sample taken by me not far below the source and submitted to him for analysis in 1905. The waters are used at Banff in the Banff Springs hotel, Government baths and various sanitariums for therapeutic treatment.

Sinclair.—Continuing westward by the C. P. R. through the Rockies to Golden, we take a steam 65 miles down the Columbia River almost southeast, and parallel to the great rocky chains to a point called Sinclair Creek. Here, at the base of a mountain slope 800 feet above the river and 2,500 feet altitude, there is a gushing stream of hot water issuing from a sheer rocky face, possessing a constant temperature of 124° F., and estimated to have a discharge of 240 gallons per minute.

This is also a strongly Sulphuretted water and similar in character to Banff water.

This point will be dealt with later under classification.

Halcyon and St. Leon.—Resuming our journey by the railway westward from Golden to Revelstoke, we leave the main line and run almost southeast for twenty-seven miles to Arrowhead, at the north of two remarkably long deep lakes, altitude 1,400 feet, through which another arm of the Columbia River flows. It should be noticed that we are naturally again proceeding parallel to other great rocky wrinkles, and, as we leave by steamboat from Arrowhead, snow-capped peaks tower up on either side the lake, one, Halcyon Peak, being 10,400 feet.

About sixteen miles due south of Arrowhead we touch Halcyon, where, within easy access of the hotel and 670 feet above the lake, two springs issue from the mountain's slope within a few feet of each other, sending up quite a cloud of vapour, in which Sulphuretted Hydrogen is unmistakeable at some distance, and quite strong where the water emerges.

The water possesses a constant temperature of 126° F., which is too hot to bear one's hand in for more than a few seconds.

There is no naked evidence of an ancient geyser basin as at Banff, though it is quite likely that investigation would prove the luxuriant vegetation surrounding the point of issue to be growing upon an enormous deposit of tufa.

It is interesting to mention here that the soil is of an extraordinary kind, light fawn in colour, and the growth therein of all garden produce and fruits, when planted in ridges and irrigated with the hot water, is something that delight's one's senses; and as one's vision strays across the placid lake 600 feet below and beyond to the snow-capped mountains merging mistically into the clouds, one feels that the place is well called Halcyon.

The Sulphuretted Hydrogen estimated at the springs amounts to 2.63 c.c. per litre, though, if it could be taken without exposure to the atmosphere, it is probably much higher. A bright silver coin was rapidly gilded, bronzed, purpled and finally blued by immersion in the water just under the rock from which it emerges.

About six miles further south down this same upper Arrow Lake brings us to St. Leon at the mouth of the creek. Some 3,000 yards back from the lake, also on the eastern mountain's slope, and 700 feet above, are two other hot springs 126° F., and similar in character to those at Halcyon.

Resuming our steamer trip still south another fifteen miles, we reach Nakusp, and I understand that about six miles to the W. N. W. of Kooshanax Creek is another hot spring, though I have not visited the spot.

Albert Canyon.—It is now necessary to return to the main C. P. R. line at Revelstoke and retrace our steps northeast for twenty miles to Albert Canyon, alt. 2227 feet, (where we might have stayed off before reaching Revelstoke.) Within a mile of the station is a warm spring of rather less importance, possessing a temperature of 80° F., and curiously enough the water is almost identical in composition with that derived from a cold spring many miles further east at a place called *Leanchoil,* about midway between Field and Golden on the main line.

Harrison, alt. 30 feet—As far as I could learn, there are no hot springs of any importance known between Revelstoke and Harrison, which is within sixty miles by railway of Vancouver.

There are several springs at this point, about five miles drive from the station. The average temperature of the waters is 150° F., being much hotter than any of the others visited, and they vary somewhat in composition.

Not having visited these springs, I cannot give my notes on their external appearance, but I understand that the evidences of a former geyser basin are very defined, and that the flow of water must at one time been something stupendous.

Composition and Classification

That some earnest effort is needed to classify and designate waters, so as to establish a namenclature of waters, is evident from the lack of such expression, and the fact of several classifications at present existing, those by (a) Peale and (b) Crook being considered the best.

(a) A system of Physiologic Therapeutics, edited by S. S. Cohen.
(b) Mineral Waters of the U. S. A. and their Therapeutic Uses.—Cohen.

The table given is Peale's classification, modified by *Haywood:

GROUP	CLASS	SUB-CLASS	GENERAL CHARACTERISTICS	
Thermal Non-thermal	I Alkaline	Carbonated and bicarbonated Borated Silicated	Sodic Lithic Potassic Calcic Magnesic Ferrugious Aluminic Arsenic Bromic Iodic Silicious Boric	Non gaseous carbondioxiated Sulphuretted Aezotized Carburetted Oxygenated
	II Alkaline saline	Sulphated Muriated Nitrated		
	III Saline	Sulphated Muriated Nitrated		
	IV Acid	Sulphated Muriated		

To differentiate between thermal and non-thermal, Dr. Peale adopts 70 F. as the dividing line, and from that up to 98.6 F. as "warm," above that as "hot."

The Banff waters may both be intelligently named Thermal-Alk-saline-sulphated-silicious-sulphuretted waters. Albert Canyon would be clearly differentiated as Thermal-alkaline-carbonated-sodic-sulphuretted water. And Comox as non-thermal-acid-muriated-silicious-ferruginous water·

NOTES ON METHODS OF ANALYSIS AND EXPRESSION

There have been and are still various methods and many forms of expressing the results of an analysis of a water, consequently it is often difficult and almost impossible to compare the results as expressed by various chemists. This has resulted from (a) lack of knowledge as to the actual combinations existing, (b) too lavishly following rules laid down by various authors, Fresenius, Cairns, Leffman and others, and (c) failure to state the actual estimations or method of calculation.

It is not difficult to prove that the methods still adopted by some analysts of giving a list of salts with figures opposite, often to two and three points of decimals, is absolutely mis-

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* **Haywood, chf. Mis. Labratory, U. S. A. Dept. of Agriculture.**

leading and affords[e] no idea either of the "ions" or the probable combinations.

Unanimity of expression and concordance with science can only be attained by strict adherence to the electrolytic theory of solutions, and giving the "ions" and the "anions" actually estimated.

As the result of making hundreds of analyses, I have come to the conclusion that more light may be thrown upon the probability of combinations depending upon the relative solvency of the various salts in various media, and since it is highly important to have as much knowledge as possible of these combinations, I have applied these principles to the obtension of the combinations as represented, and grouped the waters according to their more striking relationship and not from any single standard.

Somewhat similar principles are being followed by other water analysts, *and it is to be hoped that the adoption will become general as it is in accord with more recent knowledge, and possibly it can be elaborated and extended as our knowledge is furthered by research and experience in using the waters. Doubtless practical experience and research will proceed "pari-passu."

The facts that, at some of the springs visited, erroneous analyses have been circulated for years, and that out of some forty-three spring waters examined in the [b]United States none agreed, whilst some were totally different from the published analyses upon which the waters were sold and used internally and externally, has made me wonder how the medical profession prescribe accurately for their patients, or whether it resolves itself into repeated trials until the water and the patient agree.

Perhaps some of our medical members will be good enough to enlighten us on this point at the conclusion.

Medical and Therapeutical Value

I have compiled the following notes by reference to Crook "Mineral Waters of the U. S. A. and Their Therapeutic Uses," an excellent report on the [b]Hot Springs of Arkansas by Haywood, and I am also indebted to J. A. McArthur, M.D., of Ottawa, a specialist in thermal therapeutic treatment.

Carbonates and Bicarbonates.—Waters like Banff, Sinclair and Albert Canyon are high in Bicarbonate of Lime.

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* Mineral Waters of the U.S A., by J. K. Haywood.

(b) Hot Springs of Arkansas, by Haywood and Weed, U.S.A. Dept. of Agriculture.

(c) The Examination of Water.—Dr. Thresh.

These neutralise acid conditions and probably remove uric acid as Calcium and Magnesium urates. Action on mucus membrane remarkable, increasing flow of gastric juices, and the salts are consequently effectual in cases of dyspepsia.

The corresponding Sodium and Patassium salts appear to act also as diuretics, and are found as normal constituents of the blood, lymph and secretions of the mucus membrane. Albert Canyon and Harrison are noticeably high in Sodium Carbonate, the latter also in Potassium salts.

Whereas the Calcium salts appear to induce constipation, the Magnesium Bicarbonates act as mild laxatives. Curiously none of the waters are apparently high in Magnesium Bicarbonate, and in this respect are quite opposite to the Arkansas springs, which are very high in this constituent.

Sulphate of Calcium does not appear to be known to have any decisive action, unless by double decomposition with the other salts·

The action of *Sulphates of Magnesium and Sodium* are well known as laxatives in small doses and as cathartics in large doses. Harrison is notably high in Glauber's salt, whilst Banff and Sinclair contain effective quantities of Epsom salts, and these waters are very valuable in eliminating syphilitic, scrofulus and malarial fever poisons, also mercury and other metallic poisons. Hence *Hg* medicines can be given in larger or more frequent doses in conjunction with such waters. Waters high in these salts have to be prescribed with extreme care to the feeble and anaemic, but none of these waters are highly charged with Epsom salts, as compared with the Epsom and German springs. [c]Epsom water contains 3,000 pts per 100,000.

Chlorides of Sodium and Potassium give origin to the term "muriated" when in predominant quantities as in Harrison, and their action externally is to increase the absorptive action of the skin, and internally as an appetizer and diuretic.

Chlordies of Calcium and Magnesium are rarely present in waters, but there is a cold spring at Comox, on Vancouver Island, containing these salts. Their action is mildly laxative in quantity, but in small doses, as in the water mentioned, they appear to increase its value as a tonic.

None of the waters contain any appreciable quantity of *iron* sufficiently to entitle them to the term "Chalybeate," though Harrison and Comox contain iron, which probably improves these waters as tonics.

(c) Vide Reynolds Metals and allied bodies, part 3.

Iodides, Bromides and Borates are seldom present in what appear to be appreciable quantities, though their action is stated to be remarkable in treatment of scrofula, rheumatism and syphilitic diseases, also as sedatives.

Phosphates are rarely present in estimable quantities, in fact, so far as I am aware, have never been previously discovered in these waters. Their action beyond that of a general tonic, and possibly in cases of rickets, does not appear to be thoroughly understood.

The medical action of *Silica and Silicates* does not appear to be thoroughly understood, but several of the waters, Harrison, Halcyon and St. Leon, are remarkably high Silica. A peculiar unctuous sensation is produced from bathing in waters high in Silica, and the action of these is most valuable in skin affection.

Many of these waters are popularly referred to as *"Lithia"* waters, and in fact some of the published analyses show large quantities of Lithia. I was not working on sufficiently large volumes of water to enable me to attempt to estimate Lithium, but the flame test of the final residue never revealed more than a "trace"

Out of the forty-three waters examined by the [a]U. S. Government Analyst, including those called and sold as Lithia waters, one contained a trace, which was advertised as containing 10.3 parts per Mil., whilst curiously enough another contained 17.5, which was not sold as a Lithia water. But generally the Lithia contents are grossly exaggerated.

Sulphuretted Hydrogen is usually present in more or less distinctive quantity in hot waters, it is not always present since none of the Arkansas springs contain any at all. Most of the Canadian waters contain some and a good deal of sulphur, which is liberated on exposure to atmosphere and settles out as a precipitate, due possibly to instant oxidation of the same gas.

The curative effects of thermal waters, especially when applied under the modern "Douche Massage" practised at Aix-le-Bains and other European resorts, appear to be due to their Dermal activifying powers, which encourage all kinds of absorptive processes to set up. The pores are dilated and profuse perspiration induced by external and internal application of water, so that the whole system is suffused with water, in which condition impurities are freed by massage and readily carried to the excretory organs, whose functions, being also increased

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(a) **The Hot Springs of Arkansas, by Haywood and Weed, U.S.A. Dept. of Agriculture** the action of the salts in the water, enable them to readily and easily eject foreign and poisonous matters from the system.

EVIDENCES OF ORIGIN.

From the enormous quantities of C stored up in coal beds and the Cretaceous rocks, it has been inferred that the primitive atmosphere was very rich in carbon, that large volumes must have been dissolved by the first fluid "Magma" and remain there today. As long ago as 1866 and 1877, Berthelot and Mendelieff suggested probable carbides and probable generation therefrom of hydrocarbons.

In the Archæan rocks a highly carboniferous gneiss is found in crevices, which it was formerly suggested might be the fossilized remains of the earliest organisms, and hence termed "Eozoon" (dawn of life). It has been shown that this carboniferous material is far more likely to be an emanation from the highly carbonized magma, which has oozed up through the igneous rocks and forced itself into crevices in the Archæan rocks, further evidenced in the [b]pegmatite dykes in granite and gabros.

The Association of Pyrites [c]with these graphitic deposits is frequently noticed, and it has been shown that this association of carbon and sulphur is constantly encountered in igneous formation and has been noticed in meteorites.

Many wonderful evidences of what might be termed naturally partly purified carbonaceous products have been met with in various drilling operations into the Paleozoic rocks, affording substances similar to [d]Ozokerite, a natural earth wax occurring in Galicia and Roumania. One sample, yellow in color, obtained at Little Ochiltre, afforded on analysis C 84.35, H 12.83, N 1.68, with traces of sulphur.

The accounts given by survivors of the violent volcanic eruptions, such as devasted Martinique, in 1902, describe enormous volumes of flame, only attributable to gaseous hydrocarbons, confirmed by the [e]zonelike map of charred nature left behind. Besides which, various samples of gases evolved from volcanic sources have been collected and examined, affording successively HCl, Chlorides, SO_2, H_2O, finally CO_2, and hydrocarbons. Siemens, in 1878, being led to the conclusion

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(*a*) The Volcanic Origin of Natural Gas and Petroleum.--Coste.
(*b*) Geological Survey of Canada, by Dr. Barlow, Vol. X.
(*c*) Ditto, Vol. VIII.
(*d*) Organic Chemistry.—Perkin and Kipping.
(*e*) U.S A. Geological Survey.—R. T. Hill.
(*f*) Le Blanc on Vesuvius Eruption, 1855-6.

that vast quantities of H and carbonaceous compounds exi
in the earth.

There is a lake of boiling pitch in the Island of Trinidad, having an area of fourteen acres, and it is stated that the supply is being maintained in its centre from some internal source; at Auvergne, central France, there is a bitumen spring; in the Caucasian mountains and at Baku mud volcanoes associated with petroleum and natural gas; rivers of oil have boiled from under the Caspian Sea. At other places on the earth's crust, in what are clearly lingering exhibitions of volcanic eruption, we have fumaroles affording all kinds of salts, sulphur and wax; "Moffettes" emitting carbonic acid, as at Naples and Eifel, and the "Solfataras" or "Geysers," **and with these latter there appears to be every reason to infer that all thermal springs are directly or indirectly associated.**

At Calera Rancho, in California, hot gases, hot waters, highly sulphuretted, and petroleum, ooze out of the ground, whilst shales of the Mesozoic and Palæozoic formations are highly calcined, being bleached to porcelain by the action of the gases and liquids in their upward passage through faults and crevices.

In the southern part of the States there are some exceedingly remarkable swellings [b]on the earth's crust, which have proved to be the dome-like covers of immense reservoirs of rock salt, sulphur, oil, marsh gas and hot saline waters, generally sulphuretted. Giving an idea of these reservoirs "en passant," after the roof of one was pierced, the drill was lowered 2,100 feet without encountering the bottom, one bed of salt is 700 feet thick; a bed of sulphur in another varies from ten feet to forty feet thick. Sometimes the oil is hot, 110° F., and the gas is at such pressure as to eject strings of tools several tons in weight and lift them high into the air. And when we consider the limited area which the drill occupies, the pressure will appear to be enormous. It has been recorded at [a]1,525 pounds per square inch, but ranges about 600 pounds in new fields, as at Medicine Hat, depth of 600 to 2,500 feet.

It is therefore inferred that the oils with sulphur have been forced by violent action upwards through thousands of feet of rock, and that the heavy saline deposits such as salt and even dolomite, have crystallized out on reduction of pressure and contact with the cooler media. **That they are not now under constant pressure is evidenced everywhere by the lowering of**

(*a*) Trans-American Institution Mining Engineers.—Capt. Lucas.
(*b*) Coste on Origin Natural Gas.

the pressure as the liquid is removed until, from some of the same reservoirs from which the tools were ejected and stones and mud thrown into the air for hundreds of feet, the same wells have now to be pumped to obtain their contents of oil or gas

Therefore, explanations and theories which have been advanced from time to time, relying upon a hydrostatic internal pressure, are now held to be fallacious, since drillings in close proximity have revealed great differences in pressures at the same depth, divergences represented by 340 to 2,370 pounds per square inch. But where gas is found in the several superposed strata, there is usually a gradation of pressure increasing with the depth so that these indications taken into conjunction with the evidence previously referred to of the gradual loss of the enormous pressure initially encountered, would appear to lead to the conclusion as a " sine qua non " **that all these products, gas, oil, salts and hot waters,** originate from volcanic source and that the exhibitions of eruptive effort when first struck give an idea of the force which compressed then into their present reservoirs in the Paleozoic and Mesozoic formations, and which having now generally no connection with the internal source of pressure—the energy is simply subsiding as the reservoirs are tapped, though, as previously stated, there are cases where a more or less intimate contact with the interior magma is apparently still maintained, which undoubtedly ought to be classed with volcanic craters, just as their contact with the interior is demonstrated in appalling manner from time to time; though, so far as I can ascertain, there is no evidence that the gas or oil reservoirs in the stratified rocks are any longer being supplied from the interior. However, in the event of a sudden subsidence of the ocean or a " qua qua versal " movement of the sea bottom, during which the ocean might be admitted to the internal Magma, one could imagine, after the resulting eruptive forces had subsided, that there might again be new pockets of gases oils fixed therefrom by the sea water **and hot thermal waters all stored up** until resistance was sufficiently reduced to enable them to gush forth as they at first did as Geysers and latterly more commonly as hot springs bubbling up frequently in the old Tufa Basin, created by the playing of the original great Geysers.

It would extend this paper beyond its scope to attempt to trace any recorded evidence of the decrease in temperature or flow of the various hot springs known, but it appears to me that

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(c) Coste Journal Can. Mining Inst. Vol. VI.

It is simply the next logical step to assume that sooner or later all such springs will finally become cold. Whether by that time we shall need to requisition their curative properties or whether science will have devised means of artificially reproducing such waters, are thoughts which it appears unprofitable to follow.

But certain it is that great benefit results to patients treated at the Thermal springs and that such springs are a most valuable asset to any country.

TABLE OF COMPARISON OF NATUR

OCCURRING ON THE WESTERN LINES OF THE CAN

LOCALITY OF SPRING	DATE OF SAMPLING	TEMPERATURE OF WATER °FHT	COLOR OF WATER VIEWED IN BODY 2' DEEP	ODOUR	CHEMICAL ANALYSIS IN PARTS PER										
					CALCIUM CARBONATE	CALCIUM SULPHATE	MAGNESIUM CARBONATE	MAGNESIUM SULPHATE	SODIUM CARBONATE	SODIUM SULPHATE	SODIUM CHLORIDE	POTASSIUM CHLORIDE	SILICA	IRON AND ALUMINA OXIDES	L
BANFF MAIN SPRING SUPPLIES GOVERNMENT BATHS, C.P.R. HOTEL, SANITARIUMS ETC.	JUNE 28TH 1907	HOT 108°F	SEA GREEN	SULPHURETTED HYDROGEN 1·07 c.c. PER LITRE	13·28	51·44	·45	16·84	3·93	6·69	1·94	TRACE	2·40	·50	T
BANFF MIDDLE SPRING SUPPLIES CAVE AND BASIN AND SANITARIUM	JUNE 28TH 1907	HOT 95°F	SEA GREEN TINGED BROWN	SULPHURETTED HYDROGEN 1·71 c.c. PER LITRE	14·18	58·82	·21	19·51	2·37	11·84	1·97	TRACE	2·90 ·40	·35	T
SINCLAIR, CENTRAL KOOTENAY VALLEY ON THE COLUMBIA RIVER, 63 MILES FROM GOLDEN	AUG 13TH 1907	HOT 124°F	SEA BLUE	SULPHURETTED HYDROGEN	16·12	21·82	·34	15·88	4·39	3·63	·50	2·32	3·20	·45	
HALCYON HOT SPRINGS ON UPPER ARROW LAKE FROM REVELSTOKE.	JULY 1ST 1907	HOT 126°F	SEA BLUE TINGED BROWN	SULPHURETTED HYDROGEN 2·625 c.c. PER LITRE	1·26	18·70	·07	1·23	4·35	42·03	·59	1·34	6·00	·40	T
ST LEON HOT SPRINGS ON UPPER ARROW LAKE FROM REVELSTOKE	JULY 6TH 1907	HOT 120°F	SEA BLUE	SULPHURETTED HYDROGEN	1·70	39·61	2·40	·34	5·51	42·51	1·32	TRACE	4·20	·50	TR
HARRISON HOT SPRING LAKE SUPPLIES PRIVATE SANITARIUM	JULY 11TH 1907	HOT 150°F	SEA BLUE	SULPHURETTED HYDROGEN	1·56	24·14	TRACE	·50	7·59	47·71	42·47	4·73	6·70	2·00	TRA
FRANK ½ MILE WEST OF STATION 30 YDS FROM RAILROAD	JULY 16TH 1907	COLD	SEA BLUE TINGED GREEN	SULPHURETTED HYDROGEN.	11·70	9·07	·52	13·38	3·22	·97	1·68	·19	·85	·50	
ALBERT CANYON NEAR C.P.R. STATION WARM SPRING	JULY 8TH 1907	WARM 80°F	SEA GREEN TINGED BROWN	SULPHURETTED HYDROGEN	18·75	·54	4·43	2·61	3·90	0·00	1·81	TRACE	1·40	·40	TR
LEANCHOIL COLD SPRING FROM FIELD STATION	JULY 5TH 1907	COLD	SEA BLUE TINGED BROWN	—	22·07	·41	3·52	1·97	11·06	0·00	2·06	TRACE	1·95	·35	TRA
ALBERT CANYON	DEC 3RD	COLD	SEA BLUE TINGED BROWN	WEST OF	TUNNEL 14·87	1271 AND ·51	OBLITERATED 2·24	0·00	WHEN 13·25	TRESTLE 1·97	BRIDGE ·99	E. OF TUNNEL	REPLACED ·85	·20	BY
COMOX ON EAST COAST OF VANCOUVER ISLAND B.C.	JULY 23RD 1907		GREEN BROWN	—	3·12	CALCIUM CHLORIDE ·31	1·49	MAGNESIUM CHLORIDE ·74	5·43	0·00	1·07	TRACE	2·15	IRON OXIDE ·75	TRA

NOTE:- ALBERT CANYON AND LEANCHOIL IS AN EXAMPLE OF A WARM AND COLD WATER POSSESSING APPROXIMATELY THE SA

NATURAL HOT & COLD WATERS

E CANADIAN PACIFIC RAILWAY COMPANY.

PER 100,000						TOTAL SOLIDS IN SOLUTION	CHEMICAL CLASSIFICATION AND ANALOGY	MEDICINAL AND THERAPEUTICAL VALUE
CA	IRON AND ALUMINA OXIDES	LITHIA	BORON	[illegible] AS [illegible]	[illegible] AS [illegible]			
0	·80	TRACE		·78	4·50	102·69	WATERS HIGH IN BOTH CARBONATES & SULPHATES OF LIME, HENCE POSSESSING HIGH TEMPORARY AND PERMANENT HARDNESS. ALL CONTAIN FAIR AMOUNT EPSOM SALTS AND PHOSPHATES	I THERMAL SULPHUR AND CALCIC WATERS ESPECIALLY GOOD IN CHRONIC RHEUMATISM AND ALL FORMS OF GOUTINESS, URIC ACID COMPLAINTS, IN CHRONIC SKIN AFFECTIONS, IN GRAVEL, BLADDER CATARRH, CALCULI AND IN RENAL INSUFFICIENCY. IN TORPID LIVER, DYSPEPSIA WITHOUT FLATULENCE, PILES CONSTIPATION CHLOROSIS AND ANEMIA IN CONSTIPATED GIRLS OF INDOLENT HABIT REQUIRING THE INVIGORATING EFFECTS OF A HIGH ALTITUDE. SCROFULOUS CHILDREN, IN INCIPIENT STAGES OF PHTHISIS.
0 0	·35	TRACE		·78	4·50	117·83		
0	·45	—	TRACE	·84	3·50	77·99	SINCLAIR HIGH IN POTASSIUM	
0	·40	TRACE		·80	1·92	78·68	ALL REMARKABLY LOW IN CARBONATE BUT HIGH IN SULPHATE OF LIME. ALL REMARKABLY HIGH IN GLAUBER'S SALT, BUT LOW IN MAGNESIUM SALTS. ALL HIGH IN SILICA	II HALCYON ON ACCOUNT OF HIGH % OF LITHIA SPECIALLY ADAPTED TO KIDNEY AND BLADDER COMPLAINTS SAME AS ABOVE I IN JOINT TROUBLES EXTERNALLY IN FORM OF DOUCHE MASSAGE. HARRISON LAKE ALSO IN SYPHILIS, AND NERVOUS AFFECTIONS LIKE HEMIPLEGIA, NEURITIS, NEURALGIA, FLATULENT DYSPEPSIA ETC.
0	·50	TRACE		TRACE	1·80	97·73		
0	2·00	TRACE	TRACE	TRACE	4·00	141·40	HARRISON HIGH IN POTASSIUM AND IN COMMON SALT	
S	50			TRACE	TRACE	41·98	WATERS CONTAINING MUCH LESS SALTS THAN FOREGOING	III FRANK IN KIDNEY AND BLADDER TROUBLES AND IN CHRONIC DIARRHOEA ALSO RHEUMATISM THE OTHERS IN STOMACH AND LIVER AFFECTIONS, GRAVEL AND IN GENERAL WHERE ALKALINE CALCIC WATERS ARE INDICATED AS WELL AS RHEUMATIC AND URIC ACID AFFECTIONS AND IN NEARLY ALL THE COMMON DISORDERS OF METABOLISM AND NUTRITION!
0	·40	TRACE	TRACE	0·00	4·00	44·00	ALL CONTAIN FAIR AMOUNT CARB^E OF LIME BUT LOW IN SULPHATE. ALL REMARKABLY LOW IN GLAUBERS SALT BUT FRANK HIGH IN EPSOM SALT	
5	·35	TRACE		0·00	3·60	47·00		
ELACED 5	BY FILL ·20	—CERTAINLY	OUGHT	TO BE		UNCOVERED 34·88	AND ADULTERATION BY	SURFACE WATERS PREVENTED SAMPLE DILUTED ABOUT 1/3 VOL. BY SNOW WATER AND SURFACE WATER.
	IRON OXIDE ·75	TRACE	—	·20		15·16	WATER ENTIRELY DIFFERENT FROM FOREGOING REMARKABLE FOR CHLORIDE AND LOW TOTAL SOLIDS	IV AN EXCELLENT TABLE WATER ACID AND FLATULENT DYSPEPSIA MILD CHOLAGOGUE, PROPHYLACTIC IN RHEUMATIC AND GOUTY DIATHESIS

ELY THE SAME ANALYSIS

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